

What is claimed is:

1. A method of manufacturing a magnetic tunneling junction (MTJ) layer for a magnetic random access memory (MRAM), comprising:
  - sequentially forming a lower material layer, an insulation layer, and an upper material layer on a substrate;
  - forming a mask pattern on a predetermined region of the upper material layer;
  - sequentially removing the upper material layer, the insulation layer, and the lower material layer from around the mask pattern using plasma generated from an etching gas, wherein the etching gas is a mixture of a main gas and an additive gas having a predetermined mixture ratio and including no chlorine ( $\text{Cl}_2$ ) gas; and
  - removing the mask pattern.
2. The method as claimed in claim 1, wherein sequentially removing the upper material layer, the insulation layer, and the lower material layer from around the mask pattern, comprises:
  - loading a resultant structure having the mask pattern formed on the predetermined region of the upper material layer into an inductively coupled plasma etching apparatus; and

generating plasma over the resultant structure by uniformly supplying the etching gas into the inductively coupled plasma etching apparatus and applying a predetermined source power and a predetermined bias voltage to the inductively coupled plasma etching apparatus.

3. The method as claimed in claim 1, wherein about 10% to about 40% of the etching gas is comprised of the main gas.

4. The method as claimed in claim 1, wherein the main gas is boron trichloride ( $\text{BCl}_3$ ), and the additive gas is argon (Ar).

5. The method as claimed in claim 2, wherein a source power of from about 500 W to about 800 W is applied to the inductively coupled plasma etching apparatus.

6. The method as claimed in claim 2, wherein a bias voltage of from about 100 V to about 150 V is applied to the inductively coupled plasma etching apparatus.

7. The method as claimed in claim 1, wherein the upper material layer, the insulation layer, and the lower material layer are removed from around the mask pattern at a temperature of about 25 °C.

8. The method as claimed in claim 1, wherein at least one of the lower material layer and the upper material layer is a single magnetic layer or a multilayered material layer including at least one magnetic layer.

9. The method as claimed in claim 1, wherein the mask pattern is formed to be smaller than micro size.

10. The method as claimed in claim 1, wherein sequentially removing the upper material layer, the insulation layer, and the lower material layer from around the mask pattern comprises:

first removing the upper material layer and the insulation layer from around the mask pattern; and

then removing the lower material layer from around the mask pattern.

11. The method as claimed in claim 10, wherein before removing the lower material layer, the etching gas is adjusted to be comprised of from about 10% to about 40% main gas in accordance with etching characteristics of the lower material layer to facilitate etching of the lower material layer.

12. The method as claimed in claim 1, wherein sequentially removing the upper material layer, the insulation layer, and the lower material layer from around the mask pattern comprises:

first removing the upper material layer from around the mask pattern;  
then removing the insulation layer from around the mask pattern; and  
then removing the lower material layer from around the mask pattern.

13. The method as claimed in claim 12, wherein before removing each of the insulation layer and the lower material layer, the etching gas is adjusted to be comprised of from about 10% to about 40% main gas in accordance with etching characteristics of the insulation layer and the lower material layer to facilitate etching of the insulation layer and the lower material layer.

14. The method as claimed in claim 1, wherein sequentially removing the upper material layer, the insulation layer, and the lower material layer from around the mask pattern comprises:

first removing the upper material layer from around the mask pattern;  
and

then removing the insulation layer and the lower material layer from around the mask pattern.

15. The method as claimed in claim 14, wherein before removing the insulation layer and the lower material layer from around the mask pattern, the etching gas is adjusted to be comprised of from about 10% to about 40% main gas in accordance with etching characteristics of the insulation layer and the lower material layer to facilitate etching of the insulation layer and the lower material layer.

16. The method as claimed in claim 1, wherein the substrate is formed by sequentially depositing a titanium (Ti) layer and a titanium nitride (TiN) layer.